

# INSURANCE INSTITUTE FOR HIGHWAY SAFETY

## NEWS RELEASE

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### **REAR CRASH PROTECTION IN SUVs & PICKUPS: MOST SEAT/HEAD RESTRAINTS WOULD DO A POOR JOB OF PROTECTING PEOPLE'S NECKS IN REAR-END CRASHES**

ARLINGTON, VA — Only 6 of the seat/head restraint combinations in 44 current model SUVs are rated good for protection against whiplash injuries in rear-end crashes. None of the seat/head restraint designs in 15 pickup truck models earns a good rating. Overall 4 out of 5 SUV and pickup seat/head restraints recently evaluated by the Insurance Institute for Highway Safety are rated marginal or poor for whiplash protection (see attached ratings). This is the first time the Institute has tested SUV and pickup seats using a dummy that can measure forces on the neck during a simulated rear-end crash.

Only the seats in the Ford Freestyle, Honda Pilot, Jeep Grand Cherokee, Land Rover LR3, Subaru Forester, and Volvo XC90 models earn good overall ratings. Among those earning poor ratings are seat/head restraints in popular models such as the Chevrolet TrailBlazer, Ford Explorer, and Toyota 4Runner SUVs plus the Chevrolet Silverado pickup truck and some seats in Ford F-150 and Dodge Dakota pickups.

"Manufacturer advertising often emphasizes the rugged image of SUVs and pickups," says Institute president Adrian Lund. "However, the Institute's evaluations show seats and head restraints in many models wouldn't do a good job of protecting most people in a typical rear impact in everyday commuter traffic."

The Institute evaluates seat/head restraints in two stages. First restraint geometry is measured to determine its height and distance behind the back of

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the head of an average-size man. Seats with good or acceptable head restraint geometry then are tested dynamically on a movable platform using a dummy that measures forces on the neck. This sled test simulates a collision in which a stationary vehicle is struck in the rear by a vehicle of the same weight going 20 mph. Seats without good or acceptable geometry are rated poor overall because they cannot be positioned to protect many people in rear-end crashes.

**Good seat/head restraint design keeps head and torso moving together in a rear impact:** When a vehicle is struck in the rear and driven forward, the vehicle seats accelerate occupants' torsos forward. Unsupported, an occupant's head will lag behind the forward movement of the torso. This differential motion causes the neck to bend back and stretch. The higher the torso acceleration, the more sudden the motion, the higher the forces on the neck, and the more likely a neck injury is to occur.

"The key to reducing whiplash injury risk is to keep the head and torso moving together," Lund explains. "To ensure they move together, a seat and head restraint have to work in concert to support an occupant's neck and head, accelerating them with the torso as the vehicle is driven forward. To accomplish this, the geometry of the head restraint has to be adequate, and so do the stiffness characteristics of the vehicle seat."

A head restraint should extend at least as high as the center of gravity of the head of the tallest expected occupant. A restraint also should be positioned close to the back of an occupant's head so it can contact the head and support it early in a rear-end crash.

If a head restraint isn't positioned behind an occupant's head, it cannot support the head in a rear impact, but good restraint geometry by itself isn't sufficient. A seat also has to be designed so its head restraint doesn't move backward in a rear impact because this would prevent the restraint from catching the head. At the same time, a vehicle seat cannot be too stiff. It has to

"give" so an occupant will sink into it, moving the head closer to the restraint. The evaluation criteria take into account both static geometry and the dynamic performance of the seats and head restraints together in the test.

**Geometry is improving:** The Institute doesn't test seats with head restraints that are rated marginal or poor for geometry. These seats automatically earn a poor rating overall because their head restraints cannot be positioned to protect many taller people.

"It's encouraging that only 12 of the 58 seat/head restraint combinations we evaluated didn't make it to the testing stage because of marginal or poor geometry," Lund says. "The auto manufacturers have been working to improve this aspect of head restraint design."

Rear-end collisions are frequent, and neck injuries are the most common serious injuries reported in automobile crashes. They account for 2 million insurance claims each year costing at least \$8.5 billion. Such injuries aren't life-threatening, but they can be painful and debilitating.

**Ford takes head restraint design in one pickup model in the wrong direction:** Many of the seats the Institute tested are from 2005 model vehicles, but their designs carry over to the 2006 model year. This was expected to be the case with the Ford Ranger (also sold as the Mazda B series). When the Institute tested a seat from a 2005 Ranger, it earned a good overall rating for whiplash protection. But then Ford redesigned this seat for 2006, making the head restraint shorter by almost three inches. When the Institute evaluated the new seat, its geometric rating fell to marginal. The redesigned Ranger seat didn't qualify for dynamic testing, so it automatically earns the lowest overall rating of poor.

"Ford has been doing a good job with some of its recent seat designs such as those in the Freestyle SUV and Five Hundred sedan," Lund says. "But the new Ranger head restraint is more than three inches below the top of the head of an average-size man. This means it won't begin to provide adequate protection

for many taller people in rear-end crashes. It's puzzling why Ford decided that buyers of the new Ranger should get less protection against whiplash than people in some of its other vehicles."

**Some advanced designs provide good protection, others don't:** Seat/head restraints in the Volvo XC90 and Subaru Forester earn good overall ratings, in part because of their advanced designs that help keep the head and torso moving together in a crash. As an occupant's torso sinks into the Subaru seat during a rear crash, a mechanism in the seatback is designed to push the head restraint up and toward the back of the head. The goal of the Volvo seat is the same, but the design is different. In the XC90, the seatback includes a special hinge to reduce the forward acceleration of an occupant's torso.

The seats in the Mercedes M class are rated marginal by the Institute, but recent tests by an insurer group in the United Kingdom produced a good overall rating for M class seats fitted with an optional "active" restraint designed to move up and toward the head during a crash. Unfortunately, seats with this better head restraint design aren't yet available in M class models sold in the United States — not even as an option. A similar seat design is standard equipment in some Mercedes car models sold in the U.S. market, and the Institute will evaluate these early in 2006.

"The seats from Subaru and Volvo work well, but dynamic tests are showing that not all of these advanced designs result in improved protection," Lund points out. "For example, active head restraints in three models from Nissan — XTerra, Pathfinder, and Infiniti FX — are marginal or poor overall. In contrast, seats in the Ford Freestyle are rated good even without the bells and whistles of the advanced designs."

**Rating seat/head restraints is international effort by insurers:** Recognizing the improvements in head restraint geometry and the need to move beyond ratings based solely on geometry, the Institute joined with other whiplash injury prevention experts

in late 2000 to organize the International Insurance Whiplash Prevention Group (IIWPG). In addition to the Institute, IIWPG members include Thatcham in the United Kingdom; Allianz Centre for Technology in Germany and the German Insurance Institute for Traffic Engineering; Folksam Insurance in Sweden; Insurance Corporation of British Columbia in Canada; Insurance Australia Group; and CESVIMap in Spain. These are all research organizations supported by automobile insurers.

IIWPG conducted extensive research and testing to develop the procedures for the dynamic tests and evaluation criteria that have been used by member research groups, including the Institute, to rate the performance of seat/head restraint combinations in vehicles sold in a number of world markets. Ratings also are being released in Australia, Canada, and the United Kingdom.

**Sled test simulates rear-end collision:** Overall seat/head restraint ratings are based on a two-step evaluation. In the first step restraint geometry is rated using measurements of height and distance from the back of the head of a mannequin that represents an average-size man. Seats with good or acceptable geometric ratings are subjected to a dynamic test conducted on a crash simulation sled that replicates the forces in a stationary vehicle that's rear-ended by another vehicle of the same weight going 20 mph. A dummy specially designed to assess rear-end crash protection (BioRID) is used to measure the forces on the neck during simulated crashes. The sled is a movable steel platform that runs on fixed rails and can be programmed to re-create the accelerations that occur inside vehicles during real-world crashes.

"The sled test simulates the kind of crash that frequently occurs when one vehicle rear ends another in commuter traffic," Lund says. "People think of head restraints as head rests, but they're not. They're important safety devices. You're more likely to need the protection of a good head restraint in a collision than the other safety devices in your vehicle because rear-end crashes are so common."

The Institute's dynamic ratings of good, acceptable, marginal, or poor are derived from two seat design parameters (peak acceleration of the dummy's torso and time from impact initiation to head restraint contact with the dummy's head) plus neck tension and shear forces recorded on the BioRID dummy during the test. The sooner a restraint contacts the dummy's head and the lower the acceleration of the torso and the forces on the dummy's neck, the better the dynamic rating. A seat/head restraint's dynamic rating is combined with its geometric rating to produce an overall rating.

**End 6-page news release on seat/head restraints in SUVs & pickups**  
**4-page attachment: rear crash protection ratings of SUVs & pickups**

**For more information go to [www.iihs.org](http://www.iihs.org)**

ATTACHMENT 1A: P. 1 of 2  
DYNAMICALLY TESTED SEAT/HEAD RESTRAINTS

SUVs Make/model	Seat type	OVERALL RATING	DYNAMIC RATING	GEOMETRY OF SEAT/HEAD RESTRAINT
<b>ACURA MDX</b> 2003-06 models	ALL SEATS	P	P	G
<b>BMW X3</b> 2004-06 models	SEATS WITH ADJUSTABLE LUMBAR	P	P	A
<b>BMW X5</b> 2001-06 models	COMFORT SEATS	P	P	G
<b>BUICK RAINIER</b> 2004-06 models	ALL SEATS	P	P	A
<b>BUICK RENDEZVOUS</b> 2004-06 models	ALL SEATS	M	M	A
<b>CHEVROLET EQUINOX</b> 2005-06 models	ALL SEATS	M	M	G
<b>CHEVROLET TRAILBLAZER</b> <b>GMC ENVOY</b> <b>ISUZU ASCENDER</b> 2003-06 models	ALL SEATS	P	P	A
<b>CHRYSLER PACIFICA</b> 2004-06 models	ALL SEATS	P	P	A
<b>FORD ESCAPE</b> <b>MAZDA TRIBUTE</b> <b>MERCURY MARINER</b> 2005-06 models	ALL SEATS	A	A	G
<b>FORD EXPLORER</b> <b>MERCURY MOUNTAINEER</b> 2006 models	ALL SEATS	P	P	A
<b>FORD FREESTYLE</b> 2005-06 models	ALL SEATS	G	G	G
<b>HONDA CR-V</b> 2005-06 models	ALL SEATS	P	P	G
<b>HONDA ELEMENT</b> 2003-06 models	ALL SEATS	P	P	A
<b>HONDA PILOT</b> 2006 models	ALL SEATS	G	G	G
<b>HYUNDAI SANTA FE</b> 2001-06 models	ALL SEATS	P	P	G
<b>HYUNDAI TUCSON</b> 2006 models	ALL SEATS	P	P	G

**G** GOOD

**A** ACCEPTABLE

**M** MARGINAL

**P** POOR

Ratings of SUV seat/head restraints continue on next page...

For each seat/head restraint, REAR-END CRASH PROTECTION is an assessment of occupant protection against neck injury in rear impacts at low to moderate speeds. Such injuries usually aren't serious, but they're frequent. OVERALL RATINGS are based on a two-step evaluation. In the first step head restraint geometry (distance behind and below the head of a seated average-size man) is rated good, acceptable, marginal, or poor. Seats with good or acceptable restraint geometry then are subjected to a dynamic test simulating the forces in a stationary vehicle that's rear-ended by another vehicle of the same weight going 20 mph. Seat/head restraints with marginal or poor geometry aren't tested dynamically because they cannot protect taller people in rear-end crashes. These seats are rated poor overall. In the dynamic test, measurements are recorded on a dummy (BioRID) representing an average-size man. BioRID is designed specifically for rear-end testing at low to moderate speeds. The DYNAMIC RATINGS are derived from two seat design parameters (peak acceleration of the dummy torso and time from impact initiation to head restraint contact with the dummy head) plus tension and shear forces recorded on BioRID's neck during the test. Overall ratings are based on both geometric measurements and dynamic results.

ATTACHMENT 1A: P. 2 of 2  
DYNAMICALLY TESTED SEAT/HEAD RESTRAINTS

SUVS Make/model	Seat type	OVERALL RATING	DYNAMIC RATING	GEOMETRY OF SEAT/HEAD RESTRAINT
<b>INFINITI FX</b> 2003-06 models	ALL SEATS ACTIVE HEAD RESTRAINTS	M	M	A
<b>JEEP GRAND CHEROKEE</b> 2005-06 models	ALL SEATS	G	G	G
<b>JEEP LIBERTY</b> 2002-06 models	ALL SEATS	P	P	A
<b>KIA SORENTO</b> 2003-06 models	ALL SEATS	P	P	A
<b>KIA SPORTAGE</b> 2005-06 models	ALL SEATS	P	P	G
<b>LAND ROVER LR3</b> 2005-06 models	ALL SEATS	G	G	G
<b>LEXUS GX 470</b> 2003-06 models	ALL SEATS	P	P	A
<b>LEXUS RX 330</b> 2004-06 models	ALL SEATS	P	P	A
<b>MERCEDES M CLASS</b> 2006 models	ALL SEATS	M	M	G
<b>MITSUBISHI OUTLANDER</b> 2003-06 models	SEATS WITH PERFORATED HEAD RESTRAINTS	M	M	G
<b>NISSAN PATHFINDER</b> 2005-06 models	ALL SEATS ACTIVE HEAD RESTRAINTS	M	M	G
<b>NISSAN XTERRA</b> 2005-06 models	ALL SEATS ACTIVE HEAD RESTRAINTS	P	P	G
<b>PONTIAC TORRENT</b> 2006 models	ALL SEATS	M	M	G
<b>SATURN VUE</b> 2002-06 models	ALL SEATS	M	M	G
<b>SUBARU FORESTER</b> 2006 models	ALL SEATS ACTIVE HEAD RESTRAINTS	G	G	G
<b>TOYOTA 4RUNNER</b> 2003-06 models	ALL SEATS	P	P	A
<b>TOYOTA HIGHLANDER</b> 2004-06 models	SEATS WITH FIXED HEAD RESTRAINT TILT AND WITHOUT ADJUSTABLE LUMBAR	M	M	A
<b>TOYOTA HIGHLANDER</b> 2004-06 models	SEATS WITH HEAD RESTRAINT TILT AND ADJUSTABLE LUMBAR	P	P	A
<b>VOLVO XC90</b> 2005-06 models	ALL SEATS	G	G	G

**G** GOOD  
**A** ACCEPTABLE  
**M** MARGINAL  
**P** POOR

Ratings of SUV seat/head restraints continue on next page...



**ATTACHMENT 1B:  
SEAT/HEAD RESTRAINTS NOT DYNAMICALLY  
TESTED BECAUSE OF INADEQUATE GEOMETRY**

<b>SUVS</b> Make/model    Seat type		<b>OVERALL RATING</b>	<b>DYNAMIC RATING</b>	<b>GEOMETRY OF SEAT/HEAD RESTRAINT</b>
<b>BMW X5</b> 2001-06 models	BASE AND SPORT SEATS	<b>P</b>	not tested (see note)	<b>M</b>
<b>CADILLAC SRX</b> 2004-06 models	ALL SEATS	<b>P</b>	not tested (see note)	<b>M</b>
<b>JEEP WRANGLER</b> 2001-06 models	ALL SEATS	<b>P</b>	not tested (see note)	<b>M</b>
<b>MINI COOPER S</b> 2004-06 models	LEATHER SEATS	<b>P</b>	not tested (see note)	<b>M</b>
<b>MINI COOPER S</b> 2004-06 models	CLOTH SEATS	<b>P</b>	not tested (see note)	<b>P</b>
<b>MINI COOPER S</b> 2005-06 models	ALL SEATS	<b>P</b>	not tested (see note)	<b>M</b>
<b>SUZUKI GRAND VITARA XL-7</b> 2005-06 models	ALL SEATS	<b>P</b>	not tested (see note)	<b>M</b>

**G** GOOD  
**A** ACCEPTABLE  
**M** MARGINAL  
**P** POOR

End of ratings of seat/head restraints in SUVs

**Note:** Seat/head restraints with marginal or poor geometry aren't tested dynamically because they cannot protect taller people in rear-end crashes. These seats are rated poor overall. Seat/head restraints with good or acceptable geometry are tested dynamically (see Attachment 1A).

**ATTACHMENT 2A:  
DYNAMICALLY TESTED SEAT/HEAD RESTRAINTS**

<b>PICKUPS</b> Make/model	Seat type	OVERALL RATING	DYNAMIC RATING	GEOMETRY OF SEAT/HEAD RESTRAINT
<b>CHEVROLET COLORADO</b> <b>GMC CANYON</b> <b>ISUZU i280/i350</b> 2004-06 models	ALL SEATS	M	M	G
<b>DODGE DAKOTA</b> 2005-06 models	SEATS WITH ADJUSTABLE LUMBAR	P	P	G
<b>DODGE DAKOTA</b> 2005-06 models	SEATS WITHOUT ADJUSTABLE LUMBAR	A	A	G
<b>FORD F-150</b> 2004-06 models	SEATS WITHOUT INTEGRATED SEAT BELT	M	M	G
<b>FORD F-150</b> 2004-06 models	SEATS WITH INTEGRATED SEAT BELT	P	P	G
<b>NISSAN FRONTIER</b> 2005-06 models	SEATS WITHOUT ADJUSTABLE LUMBAR ACTIVE HEAD RESTRAINTS	P	P	A
<b>NISSAN FRONTIER</b> 2005-06 models	SEATS WITH ADJUSTABLE LUMBAR ACTIVE HEAD RESTRAINTS	P	P	G
<b>NISSAN TITAN</b> 2005-06 models	ALL SEATS ACTIVE HEAD RESTRAINTS	A	A	A
<b>TOYOTA TACOMA</b> 2005-06 models	BUCKET SEATS	M	M	G
<b>TOYOTA TUNDRA</b> 2005-06 models	BUCKET SEATS WITHOUT ADJUSTABLE LUMBAR	A	A	G
<b>TOYOTA TUNDRA</b> 2005-06 models	BUCKET SEATS WITH ADJUSTABLE LUMBAR	M	M	G

**G** GOOD

**A** ACCEPTABLE

**M** MARGINAL

**P** POOR

**ATTACHMENT 2B:  
SEAT/HEAD RESTRAINTS NOT DYNAMICALLY  
TESTED BECAUSE OF INADEQUATE GEOMETRY**

<b>PICKUPS</b> Make/model	Seat type	OVERALL RATING	DYNAMIC RATING	GEOMETRY OF SEAT/HEAD RESTRAINT
<b>CHEVROLET SILVERADO 1500</b> <b>GMC SIERRA 1500</b> 2001-06 models	SEATS WITH ADJUSTABLE HEAD RESTRAINTS	P	not tested (see note)	M
<b>CHEVROLET SILVERADO 1500</b> <b>GMC SIERRA 1500</b> 2001-06 models	SEATS WITH FIXED HEAD RESTRAINTS	P	not tested (see note)	P
<b>DODGE RAM 1500</b> 2006 models	SEATS WITHOUT ADJUSTABLE LUMBAR	P	not tested (see note)	M
<b>FORD RANGER</b> <b>MAZDA B SERIES</b> 2006 models	ALL SEATS	P	not tested (see note)	M
<b>GMC SIERRA 1500</b> 2001-06 models	SEATS WITH HEAD RESTRAINT TILT LOCK	P	not tested (see note)	M

Note: Seat/head restraints with marginal or poor geometry aren't tested dynamically because they cannot protect taller people in rear-end crashes. These seats are rated poor overall. Seat/head restraints with good or acceptable geometry are tested dynamically (see Attachment 2A).